

POSTEMERGENCE DEVELOPMENT AND INTERYEAR RESIDENCE OF JUVENILE COLUMBIAN GROUND SQUIRRELS IN THE IDAHO PRIMITIVE AREA

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ABSTRACT.—A colony of Columbian ground squirrels in the Idaho Primitive Area was observed from 1976 to 1978. Seven body measurements were recorded for juveniles obtained in 1978. There was a lack of sexual dimorphism among developing juveniles. The hind foot was the fastest developing feature. Juveniles obtain adult size their second year. Juvenile males exhibited the lowest interyear residency of either sex or age group examined.

Pengelley (1966), in a comparison of developmental patterns of four species of ground squirrels (Genus: *Spermophilus*), noted that developmental rates appeared to have an adaptive value for the particular habitats occupied by each species. Thus an understanding of the developmental pattern of a particular species may provide insight into the basic ecology of that species. Information on various aspects of growth and development for several species of *Spermophilus* has been reported (Svihla 1939, Blair 1942, Mayer and Roche 1954, Tomich 1962, McKeever 1964, Neal 1965, Clark 1970, Iverson and Turner 1972, Zimmerman 1972, Michener 1974, Turner et al. 1976), but little data have been compiled for the Columbian ground squirrel (*Spermophilus columbianus*). Levenson (1979) presented a growth rate constant from birth to 50 days for *S. columbianus* and Shaw (1925) traced the development of Columbian ground squirrels from birth to emergence from the den, but information concerning postemergence development is lacking.

METHODS

A description of the Cold Meadows study area and trapping procedure used have been described elsewhere (Elliott and Flinders 1980). In addition to ground squirrels live trapped, specimens were collected from outside the trap grid using a small caliber rifle. Postemergence development reported here is based on data acquired during the 1978 field season.

RESULTS AND DISCUSSION

Seven body measurements were taken on each sex of juvenile (juvenile = young of the year) Columbian ground squirrel live trapped or shot (Table 1). No significant difference (unpaired t-test) was found between measurements of males and females (excluding body weights for July or August). This lack of sexual dimorphism in developing ground squirrels has been observed for other spermophiles (Kiell and Millar 1978).

TABLE 1. Mean measurements (\pm SD) of juvenile Columbian ground squirrels collected at Cold Meadows, Idaho Primitive Area, 1978.

Date	Sex	N	Foot length	Ear length	Tail length	Total length	Body weight	Zygomatic breadth	Condylobasal length
July 17-24	M	4	47 \pm 1 mm	17 \pm 1	82 \pm 5	258 \pm 14	200 \pm 34 g	27 \pm 2	49 \pm 3
	F	8	46 \pm 2	17 \pm 1	82 \pm 7	258 \pm 15	173 \pm 34	27 \pm 1	51 \pm 3
	Combined	12	46 \pm 1	17 \pm 1	82 \pm 6	258 \pm 14	182 \pm 35	27 \pm 1	50 \pm 3
August 14-21	M	9	50 \pm 1	18 \pm 1	82 \pm 4	280 \pm 7	311 \pm 43	30 \pm 2	52 \pm 3
	F	9	49 \pm 1	17 \pm 1	81 \pm 3	276 \pm 11	264 \pm 31	29 \pm 3	49 \pm 1
	Combined	18	49 \pm 1	18 \pm 1	82 \pm 3	278 \pm 9	288 \pm 41	29 \pm 2	50 \pm 2

TABLE 2. Size of juvenile Columbian ground squirrels expressed as a percent of the size of adults taken during the same collection period in Cold Meadows, Idaho Primitive Area, 1978.

Date	Sex	Foot length	Ear length	Tail length	Total length	Body weight	Zygomatic breadth	Condylolbasal length
July 17-24	M	92	85	87	78	33	80	84
	F	93	86	92	81	34	83	90
	Combined	92	85	89	79	32	82	88
August 14-21	M	98	89	87	84	53	88	89
	F	99	89	91	87	51	89	87
	Combined	98	89	89	86	52	89	88

The body dimensions were compared (Table 2) to corresponding measurements of 76 adult squirrels taken in the same collection periods. The hind foot was the fastest developing item measured, a feature also noted in *S. richardsonii* (Clark 1970), *S. lateralis* (Clark and Skryja 1969), *S. parryii* (Kiell and Millar 1978), *S. tereticaudus* (Neal 1965), and *S. harrisii* (Neal 1965). All measurements except tail length and condylolbasal length were significantly larger (unpaired t-test, $P < 0.01$) during August than July. Shaw (1925) noted Columbian ground squirrels did not complete their growth cycle until the second season. Based on 12 juveniles captured in 1977 and recaptured in 1978, ground squirrels at Cold Meadows also obtain adult size their second year of life. The combined proportions for both sexes in August (Table 2) indicate approximately 90 percent of the adult dimensions (excluding body weight) are obtained by the end of the first season. This delaying of maturity has been observed in other species of *Spermophilus* (Bridgwater 1966, Morton and Tung 1970). Morton et al. (1974) noted that in *S. beldingi* fattening and overall growth were concurrent at first but that caloric intake was then diverted primarily toward lipid synthesis and storage for catabolism during hibernation. This caloric diversion resulted in a late season slowing of increase in linear dimensions. The Columbian ground squirrels at Cold Meadows are active four months out of the year, hibernating for the remaining period. The necessity to "trade off" calories for body growth to develop greater body reserves for hibernation may account for the inability of juveniles to attain adult size their first season.

Utilizing capture-recapture data acquired during 1976-1978, the percent interyear residence for each sex and age group of *S.*

TABLE 3. Percent interyear residence of Columbian ground squirrels at Cold Meadows, Idaho Primitive Area, 1976-1978.

	1977		1978	
	recaptures/ 1976 captures	Percent	recaptures/ 1977 captures	Percent
Adult males	10/16	62.5	5/13	38.4
Adult females	16/22	72.7	7/20	35.0
Juvenile males	3/14	21.4	2/12	16.6
Juvenile females	4/9	44.4	3/9	33.3

columbianus was calculated (Table 3). Juvenile males exhibited the lowest rate of fidelity. Michener and Michener (1971) observed the same residency pattern for *S. richardsonii*. Reasons for the absence of juvenile male ground squirrels has been postulated to be the result of dispersal (Evans and Holdenried 1943, Fitch 1948, McCarley 1966, Quanstrom 1971, Yeaton 1972), exceptional vulnerability to predation (Schmutz 1979), and/or overwinter mortality (Michener and Michener 1977). We did not determine which specific factor(s) resulted in the observed low juvenile male interyear residency for the Cold Meadows colony.

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LITERATURE CITED

- Blair, F. W. 1942. Rate of development of young spotted ground squirrels. *J. Mammal.* 23: 342-343.

- BRIDGWATER, D. D. 1966. Laboratory breeding, early growth, development and behavior of *Citellus tridecemlineatus* (Rodentia). Southwestern Nat. 11:325-337.
- CLARK, T. W. 1970. Early growth, development and behavior of the Richardson ground squirrel (*Spermophilus richardsoni elegans*). Amer. Midl. Nat. 83:197-205.
- CLARK, T. M., AND D. D. SKRYJA. 1969. Postnatal development and growth of the golden-mantled ground squirrel, *Spermophilus lateralis lateralis*. J. Mammal. 50:627-629.
- ELLIOTT, C. L., AND J. T. FLINDERS. 1980. Seasonal activity pattern of Columbian ground squirrels in the Idaho Primitive Area. Great Basin Nat. 40:175-177.
- EVANS, R. C., AND R. HOLDENRIED. 1943. A population study of the Beechey ground squirrel in central California. J. Mammal. 24:231-260.
- FITCH, H. S. 1948. Ecology of the California ground squirrel on grazing lands. Amer. Midl. Nat. 39:513-596.
- IVERSON, S. L., AND B. N. TURNER. 1972. Natural history of a Manitoba population of Franklin's ground squirrels. Can. Field-Nat. 86:145-149.
- KIELL, D. J., AND J. S. MILLAR. 1978. Growth of juvenile arctic ground squirrels (*Spermophilus parryi*) at McConnell River, N. W. T. Can. J. Zool. 56:1475-1478.
- LEVENS ON, H. 1979. Sciurid growth rates: some corrections and additions. J. Mammal. 60:232-235.
- MAYER, W. V., AND E. T. ROCHE. 1954. Development patterns in the Barrow ground squirrel, *Spermophilus undulatus barrowensis*. Growth 18:53-69.
- MCCARLEY, H. 1966. Annual cycle, population dynamics and adaptive behavior of *Citellus tridecemlineatus*. J. Mammal. 47:294-316.
- McKEEVER, S. 1964. The biology of the golden-mantled ground squirrel. Ecol. Monogr. 34:383-401.
- MICHENER, D. R., AND G. R. MICHENER. 1971. Sex ratio and interyear residence in a population of *Spermophilus richardsonii*. J. Mammal. 52:853.
- . 1974. Annual cycle of activity and weight change in Richardson's ground squirrel *Spermophilus richardsonii*. Can. Field-Nat. 88:409-413.
- MICHENER, G. R., AND D. R. MICHENER. 1977. Population structure and dispersal in Richardson's ground squirrels. Ecology 58:359-368.
- MORTON, M. L., AND H-C. L. TUNG. 1971. Growth and development in the Belding ground squirrel (*Spermophilus beldingi beldingi*). J. Mammal. 52:611-616.
- MORTON, M. L., C. S. MAXWELL, AND C. E. WADE. 1974. Body size, body composition and behavior of juvenile Belding ground squirrels. Great Basin Nat. 34:121-134.
- NEAL, B. J. 1965. Growth and development of the round-tailed and Harris antelope ground squirrels. Amer. Midl. Nat. 73:479-489.
- PENGELLEY, E. T. 1966. Differential developmental patterns and their adaptive value in various species of the genus *Citellus*. Growth 30:137-142.
- QUANSTROM, W. R. 1971. Behaviour of Richardson's ground squirrel *Spermophilus richardsonii richardsonii*. Anim. Behav. 19:646-652.
- SCHMUTZ, S. M., D. A. BOAG, AND J. K. SCHMUTZ. 1979. Causes of unequal sex ratio in populations of adult Richardson's ground squirrels. Can. J. Zool. 57:1849-1855.
- SHAW, W. T. 1925. Breeding and development of the Columbian ground squirrel. J. Mammal. 6:106-113.
- SVIHLA, A. 1939. Breeding habits of Townsend's ground squirrel. Murrelet 20:6-10.
- TOMICH, P. Q. 1962. The annual cycle of the California ground squirrel, *Citellus beecheyi*. Univ. Calif. Pub. Zool. 65:213-282.
- TURNER, B. N., S. L. IVERSON, AND K. L. SEVERSON. 1976. Postnatal growth and development of captive Franklin's ground squirrels (*Spermophilus franklinii*). Amer. Midl. Nat. 95:93-102.
- YEATON, R. I. 1972. Social behavior and social organization in Richardson's ground squirrel (*Spermophilus richardsonii*) in Saskatchewan. J. Mammal. 53:139-147.
- ZIMMERMAN, E. G. 1972. Growth and age determination in the thirteen-lined ground squirrel, *Spermophilus tridecemlineatus*. Amer. Midl. Nat. 87:314-325.